

Name:
Enrolment No:



UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Term Examination, December 2022

Program Name: B. Tech Chemical Engineering (Spl. In Refining and Petrochemicals)
Course Name: Process Modelling and Simulation
Course Code: CHCE 4013P
Nos. of page(s) : 01
Instructions: OPEN BOOKS and OPEN NOTES

Semester: VII
Time : 3 h
Max. Marks: 100

SECTION A – ANSWER ANY TWO QUESTIONS

S. No.		Marks	CO
Q1.	<p>Some of the condensation reactions when formaldehyde (F) is added to sodium parphenolsulfonate (M) in an alkaline-aqueous solution have been studied. The initial concentration of Formaldehyde (F) and parphenolsulfonate (M) are the last two digits of your SAP ID (mol/h) and last two digits of your Roll No. (mol/h), respectively. It was found that the reactions could be represented by the following equations:</p> $ \begin{array}{ll} F + M \rightarrow MA, & k_1 = 0.15 \text{ L/gmol min} \\ F + MA \rightarrow MDA, & k_2 = 0.49 \\ MA + MDA \rightarrow DDA, & k_3 = 0.14 \\ M + MDA \rightarrow DA, & k_4 = 0.14 \\ MA + MA \rightarrow DA, & k_5 = 0.04 \\ MA + M \rightarrow D, & k_6 = 0.056 \\ F + D \rightarrow DA, & k_7 = 0.50 \\ F + DA \rightarrow DDA, & k_8 = 0.50 \end{array} $ <p>where M, MA, and MDA are monomers and D, DA, and DDA are dimers. The process continues to form trimers. The rate constants were evaluated using the assumption that the molecularity of each reaction was identical to its stoichiometry. Derive a dynamic model for these reactions taking place in a single, isothermal CSTR. Carefully define your terms and list your assumptions.</p>	50	CO1, CO2
Q2	<p>Semi-batch reactors are operated as a cross between batch and continuous reactors. A semi-batch reactor is initially charged with a volume of material, and a continuous feed of reactant is started. There is, however, no outlet stream. Develop the modelling equations for a single first-order reaction. The state variables should be the volume and concentration of reactant A.</p>	50	CO2
Q3	<p>As discussed during the Class, using 7 lump parameter model</p> <ul style="list-style-type: none"> Derive the set of kinetic equations for all possible reactions in an FCC riser column. [25 marks] Identify all the constants, independent and dependent variables [15 marks] Suggest the numerical technique(s) to solve the derived equations. [10 marks] 	50	CO1, CO3